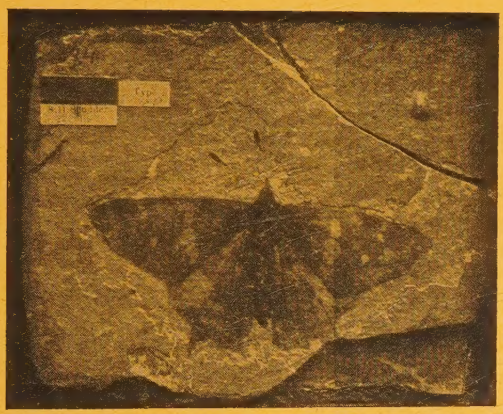
PSYCHE

A JOURNAL OF ENTOMOLOGY

ESTABLISHED IN 1874

VOL. XXVIII AUGUST, 1921 NUMBER 4



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CONTENTS

Reproduction in the Aphididæ with a consideration of the modifying influence of Environmental Factors. *L. B. Vichanco* 95

Chinese Ants collected by Prof. C. W. Howard. *W. M. Wheeler* 110

On some recent remarks on the Phylogeny of Homoptera *F. Muir*.... 116

Notes and Description of a few North American Dolichopodidæ (Diptera) *M. C. Van Duzee* 120

Cicadella gothica Sign.— A Correction. *G. W. Barber* 130

Spiders Feeding on Small Cyprinodonts. *T. Barbour* 131

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PSYCHE is published bi-monthly, the issues appearing in February, April, June, August, October and December. Subscription price, per year, payable in advance: $2.00 to subscribers in the United States, Canada or Mexico; foreign postage, 15 cents extra. Single copies, 40 cents.

Cheques and remittances should be addressed to Treasurer, Cambridge Entomological Club, Bussey Institution, Forest Hills, Boston 30, Mass.

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Reprints of articles may be secured by authors, if they are ordered before, or at the time proofs are received for corrections. The cost of these will be furnished by the Editor on application.

Entered as second-class mail matter at the Post Office at Boston, Mass. Acceptance for mailing at special rate of postage provided in Section 1103, Act of October 3, 1917, authorized on June 29, 1918.

PSYCHE

VOL. XXVIII AUGUST, 1921 No. 4

REPRODUCTION IN THE APHIDIDÆ WITH A CONSIDERATION OF THE MODIFYING INFLUENCE OF ENVIRONMENTAL FACTORS.[1]

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Literature on aphids abounds in references to the existence of an "asexual" and a "sexual" reproduction. As a matter of fact, however, they reproduce sexually only, the term "sexual reproduction" being generally accepted by zoölogists as meaning reproduction by means of special reproductive cells, and "asexual reproduction" that method which involves a direct division, or budding, of an animal without the intercession of specific germ cells.

Reproduction in aphids may be subdivided into two categories: 1. *Amphigony.* This involves the union of reproductive cells of both sexes, the female gamete, or egg, necessitating fertilization by the male gamete, or spermatozoön, as a prerequisite to development. 2. *Parthenogenesis.* In this mode of reproduction the male gametes are dispensed with, the egg developing without having been previously fertilized. Hertwig and Kingsley (1912, p. 130) characterize parthenogenesis as "a sexual reproduction in which a degeneration of fertilization has taken place." In addition to the two foregoing methods of reproduction, occasional cases of *pædogenesis* (e. g., in *Aphis avenæ* Fabricius, as reported by Ewing, 1916, and in *Toxoptera graminum* Rondani, Webster and Phillips, 1912) have been reported. Pædogenesis is parthenogenesis occurring in the preadult stages of animals.

Amphigonous reproduction is considered as the more primitive method in insects, parthenogenesis being the result of a later specialization. The latter method of reproduction has become of normal occurrence in aphids and has practically supplanted the former, amphigony taking place only under the influence of adverse conditions in the environment. We have thus in aphids a

[1] Contribution from the Entomological Laboratories of the Bussey Institution, Harvard University. No. 191.

very remarkable instance of a highly specialized group of sexually reproducing animals in which fertilization of the female reproductive cells as a prelude to development has been reduced to an apparently unnecessary and unessential physiological process.

General Features of Amphigony in Aphids.

In the amphigonous generation both sexes are, of course, represented. The presence of the male is the only characteristic of the amphigonous generation.

The main external characteristics of an amphigonous female are the general absence of wings (Baker, 1920), and the presence of an ovipositor in certain species (Buckton, 1882, p. 119). Davis (1908) also noted the presence of "sensoria" on the hind tibiæ as a secondary sexual character of the amphigonous female, "at least in the subfamilies Pemphiginæ, Schizoneurinæ, Lachininæ and Aphidinæ."[2] Internally, the most conspicuous features are the presence of a spermatheca and a pair of collaterial glands. The acessory glands, as well as the vagina, of which they are an evagination, and also the oviducts, are easily recognizable on account of their relatively thick walls. The large amphigonous eggs and their nurse cells are also very characteristic and are in evidence in the ovaries early in the embryonic stage of the mother. Cleavage and the formation of the blastoderm do not begin until after the eggs are fertilized and deposited. The amphigonous female is oviparous. The eggs are covered with a vitelline membrane and chorion.

General Features of Parthenogenesis in Aphids.

Among the aphids of temperate countries, aphidologists distinguish between (1) "stem mothers," which are the parthenogenetic individuals hatching from the overwintering amphigonous eggs, and (2) later parthenogenetic generations. The former are typically apterous; the latter, either apterous or alate. In the fall

[2] The typical genus of Schizoneurinæ, which is Schizoneura Hartig, 1837, is considered by Baker (1920) as a synonym of Eriosoma Leach, 1818. He grouped the latter under the tribe Eriosomatini of the subfamily Eriosomatinæ. The subfamily Pemphiginæ has been reduced by the same author to tribe Pemphigini under the subfamily Eriosomatinæ; and Lachninæ, to Lachnini under Aphidinæ.

there is also a third form, the generation of 'sexupara," that is, parthenogenetic individuals which give rise to amphigonous forms. These are, as a rule, alate (Patch, 1920). In all specimens of parthenogenetic aphids which I have dissected neither spermatheca nor colleterial glands were found. The absence of these structures was apparently first reported by von Siebold (1839) and subsequently confirmed by other authors. In contrast with the amphigonous forms, the walls of the ovary are uniformly thin and membraneous, except at the vagina, where they are somewhat thicker.

Parthenogenetic aphids are viviparous, the entire incubation period being passed within the abdomen of the mother. This is a very unique characteristic, in view of the fact that a similar case does not occur in closely related families. The Phylloxeridæ, which is the only other family with the Aphididæ in the superfamily Aphidoidea, also have parthenogenetic generations, but they are always oviparous. In certain other families of the order Homoptera, like the Aleyrodidæ, parthenogenesis and viviparity are not correlated.

In parthenogenetic aphids, the development of the eggs proceeds in the ovaries long before deposition, eggs in the blastoderm stage having been observed within the abdomen of parthenogenetic embryos. There is no formation of a vitelline membrane and chorion.

Modifying Factors in the Production of Amphigonous Individuals.

As has been suggested elsewhere in the present paper, aphids seem to have the tendency indefinitely to reproduce parthenogenetically under favorable environmental conditions. As experimental evidence favoring this view may be cited Ewing's (1916) work on *Aphis avenæ* Fabricius, in which he found that he could maintain continuous and uninterrupted parthenogenetic reproduction through as many as eighty-seven generations in the material he experimented with on the Pacific Coast of the United States. In that region, oviparous forms in any aphid species had not been known, except in very few cases. His experiments, unfortunately, had to be brought to a close through the dying of all the individuals in his eighty-seventh generation from excessive heat; otherwise, he would probably have been able to observe parthogenetic reproduc-

tion for a much longer period, if not indefinitely. Earlier investigators, like Bonnet (1745) and Kyber (1815), had previously observed the maintainence of continuous parthenogenetic reproduction in various species of aphids for long periods of time.

Males and oviparous females are known to be produced only under the prolonged influence of extremes of temperature, such as during the winter in temperate climates, and, as certain investigators claim, in cases of scarcity of food. Observations on this modifying action of climate and food, according to Buckton (1882, p. 109) were reported by Bonnet in 1745, and later confirmed by De Geer in 1773.

From our somewhat fragmentary knowledge of tropical aphids, we may tentatively infer, in the absence of more definite evidence to the contrary, that representatives of this family reproduce exclusively by parthenogenesis in warm countries. The following table gives a partial list of the localities in which a continuous parthenogenetic reproduction throughout the year has been observed. It will be noted that the various localities included in the list are characterized either by the total absence of winter or by a relatively mild climate.

LOCALITY	SPECIES	AUTHORITY
France (Orleans)	*Aphis rumicis* L.	Gaumont (1913)
Germany (Bremen?)	*Hyalopterus trirhodus* Walk.	Börner (1914)
	Rhophalosiphum lactucæ Kalt.	*ditto*
Holland	*Aphis gossypii* Glov.	van der Goot (1915)
	Aphis hederæ Kalt.	*ditto*
	Aphis abietina Walk.	*ditto*
	Aphis rumicis L.	*ditto*
	Eriosoma lanigera Hausm.	*ditto*
	Macrosiphum granarium Kirby	*ditto*
	Myzus persicæ Sulz.	*ditto*
India	*Aphis brassicæ* L.	Maxwell-Lefroy (1907)
	Aphis cardui L. var.	*ditto*
	Aphis gossypii Glov.	*ditto*

South Africa	*Myzus persicæ* Sulz.	Moore (1912)
Sudan	*Aphis sorghi* Theob.	Vuillet (1914)
Sudan, Anglo-Egyptian	*Aphis sorghi* Theob.	Theobald (1904)
United States:—		
California	*Aphis avenæ* Fabr.	Ewing (1916)
	Macrosiphum rosæ Ream.	Russell (1914)
Florida	*Aphis brassicæ* L.	Quaintance (Herrick, 1911)
Indiana[3]	*Macrosiphum granarium* Kirby	Phillips (1916)
Texas	*Aphis pseudobrassicæ* Davis	Paddock (1915)
Virginia[3]	*Macrosiphum granarium* Kirby	Phillips (1916)
South Carolina	*Callipterus trifolii* Monell	Davis (1914)
Southern U. S.[4]	*Toxoptera graminum* Rond.	Webster and Phillips (1912)
Washington	*Pemphigus betæ* Doane	Doane (1900)

Supplementary to the above data may be cited here the other paper of van der Goot (1917, p. 2), who, after three years of biological and taxonomic work on the Aphididæ in Java, reported that he had never found amphigonous individuals in that country—not even at high mountain elevations where the temperature falls to the freezing point at night. Likewise, several years of casual observation and collecting in the Philippine Islands by me failed to disclose the male and oviparous-female forms. So far as I am aware, the occurrence of amphigonous aphid individuals in any other tropical country has not been definitely reported. It should be borne in mind, however, that failure to discover such forms in a given locality does not prove their non-existence there; although, when workers carrying on investigation for years in tropical regions report their inability to find amphigonous forms in any season of the year, there is some ground for suspicion that partheno-

[3] Amphigonous individuals and winter eggs of that species also found in this locality.

[4] South of the 35th parallel.

genetic reproduction is continuous and uninterrupted, at least among the more common species of tropical aphids. If such a condition does obtain, the most reasonable explanation appears to be that in the tropics conditions are relatively more uniformly favorable to the aphids, both with respect to the climate and the nutritive factors in the environment.

Patch (1920), on the other hand, in a very interesting general treatise on the life cycle of aphids, remarks that "in tropical climates experiencing a wet and a dry season gamogenetic [amphigonous] eggs are produced to tide over the period of famine"; but unfortunately she does not cite any specific evidence or authority to support her thesis. It is not improbable, however, that some rare cases of amphigonous forms might occur in those tropical countries where, as she suggests, the year is divided between a wet and a dry season,[5] in view of the fact that in the height of the hot, dry season, when conditions are less favorable for many living organisms, certain species of insects are known to assume a resting state, presumably corresponding to hibernation in temperate climates.

[5] Such a condition obtains in the Philippine Islands, Java, and many other countries of the tropics of both hemispheres.

In temperate countries, as a rule, reproduction of aphids by parthenogenesis is continuous during the milder seasons of the year, and amphigonous forms do not appear until the onset of the fall, when the low temperatures begin to affect the insects unfavorably. Exceptions to this generality are determined by the modification of the climate in a given region through the agency of various factors, such, for instance, as the prevailing winds blowing from the ocean and causing the summers to be "more moderate and the winters milder" on the Pacific Coast of the United States than in regions situated at similar latitudes in the interior and on the Eastern Coast.[6] The aphids in the former locality are thus subjected to comparatively more favorable conditions throughout the year and, consequently, they rarely, if ever, undergo heterogony (Ewing, 1916, and Swain, 1919, p. 8).

[6] R. DeC. Ward. 1918. Climate Considered Especially in Relation to Man, second edition, revised: 44. xvi+380 pp. G. Putnam's Sons, New York and London.

The Nature of Influence of Extremes of Temperature and Lessening of Food Supply in the Determination of Amphigony.

It may be inferred from the foregoing considerations that winter, with its attendant low temperatures and inadequate food supply, plays a very important, if not an exclusive, part in the determination of amphigony. Amphigony correspondingly becomes of less frequent occurrence as winter becomes less severe in a locality, until in tropical regions where the temperature and, incidentally, the food supply also are more equably maintained throughout the year, amphigonous froms occur very rarely, if at all.

In this connection, it is interesting to note that, although heterogony has been brought about evidently as an adaptation to unfavorable environmental factors, the effects of low temperatures do not seem to be a necessary immediate stimulus in the production of amphigonous individuals and that aphid strains normally undergoing heterogony may continue to produce an amphigonous generation and lay eggs at least in the fall following the spring of the same year in which the insects from the open are taken into the greenhouse. The following experimental evidence, which has led me tentatively to arrive at this conclusion, is based on preliminary observations, which will have to be confirmed by further investigations under more adequate control:

In July, 1920, seedlings of *Tanacetum vulgare* Linnæus were transferred to the greenhouse of the Bussey Institution. At about the middle of August, after the plants had been well started, they were inoculated with their common aphid pest, *Macrosiphum tanaceti* Linnæus. The host plants appeared to grow normally and the aphids continually reproduced parthenogenetically until about the end of October, 1920. In October the temperature outdoors began to fall every now and then, especially at night, and at this time the greenhouse was kept heated to an average of about 65°F. This temperature had been observed previously by Ewing (1916) to be the optimum for aphids, in that it is least stimulating to the production of wings in the viviparous forms; and this behavior may be interpreted as an indication that the insects were under more favorable environmental conditions than the individuals which showed greater tendency to produce wings when subjected to other

temperatures. In spite of the precautions observed in the present experiments, at about the end of October and the first week of November, 1920, when the tansy plants were still in apparently good condition, the aphids produced amphigonous individuals and laid winter eggs, in the same manner as the insects of identical species which were exposed to the more adverse weather conditions in their natural environment outdoors.

In the same greenhouse were a number of plants of *Nicotiana alata* Otto et Fink. These had been observed by me since September, 1919, to be infested with *Myzus persicæ* Sulzer. The insects, which are a common greenhouse pest in this part of the country, were probably descendants of parents that had been associated with greenhouse plants for a long period of time, and thus had been continually protected for generations from the drastic effects of winter. These individuals of *Myzus persicæ* in the greenhouse, which were under the influence of the same temprature conditions as the tansy aphids, continuously reproduced parthenogenetically throughout the winter of 1919-1920 and of 1920-1921.

At the time the above experiments were conducted, there was no facility available for a more accurate regulation of temperature and other conditions. The simultaneous presence in the same place of parthenogenetic forms of *Myzus persicæ,* however, tends to eliminate to some extent the possibility of adverse conditions existing in the greenhouse and bringing about amphigony in *Macrosiphum tanaceti.* Another difficulty in the present experiments was that I had no opportunity to work with material of identical species for control. However, under natural conditions outdoors in this locality, both *Myzus persicæ and Macrosiphum tanaceti* begin to produce winter eggs at about the same time of the year, in the fall.

In apparent contradiction to my findings on *Macrosiphum tanaceti* are the results reported by Slingerland (1893) in his work on *Myzus achyrantes* Monell, which species is considered by Gillette and Taylor (1908) as a synonym of *M. persicæ.* On April 2, 1890, Slingerland isolated the nymph of a wingless, parthenogenetic female, and within two years and ten months from that date he succeeded in raising from his material sixty-two successive generations of parthenogenetic individuals. The work was done

at the Cornell Agricultural Experiment Station, at which locality winter is more or less severe, and this species is known, under natural conditions, to undergo an alternation of generations during the year. It should be noted, however, that *Myzus achyrantes* is a common pest of the greenhouses in Ithaca, as Slingerland himself admits in his paper. It is highly probable, although he does not specifically say so, that he obtained his material of this species from stock which had been in existence in the greenhouse for generations, and, as was the case with *Myzus persicæ* in the present experiments, the progenitors of the nymph with which he started his cultures might have come from a strain that had been reproducing exclusively by parthenogenesis as a result of prolonged seclusion from the untoward effects of winter. Under these circumstances then, Slingerland's results would tend to corroborate mine, instead of contradicting them. Nor would Ewing's (1916) eighty-seven continuous parthenogenetic generations of *Aphis avenæ* disprove my results, in view of the fact that the source of his material was the Pacific Coast of the United States, where this aphid has been known to reproduce normally by parthenogenesis for indefinite periods. This author himself states in his paper that he was unable to find amphigonous forms of the species outdoors during the entire time that his experiments were in progress. The results reported by earlier investigators, like Bonnet (1745) in France, on nineteen continuous parthenogenetic generations of *Aphis sambuci* Linnæus, and Kyber (1815) in Germany on parthenogenetic reproduction during a four-year period by *Macrosiphum rosæ* Linnæus (=*Siphonophora rosæ* Koch) and *Myzus persicæ* Sulzer (=*Rhophalosiphum dianthi* Schrank), may have to be classed in the same category as Ewing's or Slingerland's, for the reason that (1) at least one species, *Myzus persicæ,* as I have stated, is a common greenhouse pest, and (2) the material with which they worked might have come from stocks which, in their respective localities, had been reproducing outdoors normally by parthenogenesis throughout the year, cases of which have been reported lately from both countries (Gaumont, 1913, and Börner, 1914). In this event, their results would not tend to contradict mine.

It would not be safe, on the basis of the foregoing evidence, to

formulate definite conclusions. The present observations, however, suggest the following preliminary deductions:

1. Heterogony in certain aphids of temperate climates has probably become a rhythmic process, occurring regularly at definite periods in their yearly cycle of generations and independently, for a period at least, of the immediate stimulus brought about by adverse temperature conditions.

2. Amphigonous reproduction in these aphids, although evidently maintained as an adaptation to, and under the influence of adverse climatic conditions, continues to occur at these definite cyclical intervals for some time after the causative factors have been removed.

The foregoing views find additional support in the fact that in nature in temperate climates amphigonous and parthenogenetic individuals of identical species in the same locality and feeding on the same parts of a host plant live side by side for considerable periods of time, even weeks, on the onset of the fall. I have noticed such a condition in Boston, and other workers have observed it elsewhere. This failure of all the individuals to respond simultaneously in the same manner to a given condition of the environment tends to show that environmental factors do not furnish the immediate or adequate stimulus in the determination of amphigony.

In 1907 Tannreuther (1907), in a paper on *Melanoxanthus salicis* Weed, *M. salicicola* Thomas, and several other species of aphids, announced somewhat similar views. He said in part that "external conditions, whether severe or normal, would not bring about the production of sexual generation before a definite number of parthenogenetic generations had intervened." He further noted, after two seasons of experimentation, that "if a stem mother and offspring were kept in favorable conditions in the greenhouse on the same species of hosts as out of doors, the time and length of period for each succeeding generation was approximately the same as out of doors, and that in both instances the sexual females and males appeared after the intervention of six parthenogenetic generations."

It may be necessary, at this juncture, to call particular attention to the fact that in the foregoing discussion the rôle of temperature in influencing the form of aphid reproduction is by no

means belittled. As has been stated above, adverse temperature conditions evidently play a very important part in the determination of amphigony, and a uniformly mild temperature is apparently conducive to an indefinite maintainance of parthenogenetic reproduction. The point suggested, however, is that the effect of continuous subjection of an aphid strain which normally undergoes heterogony to mild temperature does not immediately become manifest. But this fact does not preclude the possibility that the cumulative effects on more than one yearly cycle of generations might bring about a change in the method of reproduction to one of continuous parthenogenesis. I have no data bearing on the reaction of the greenhouse aphids which reproduce continuously by parthenogenesis to the adverse weather conditions outdoors during the fall and winter months.

I am not prepared to discuss from personal observations the relation between scarcity of food and the determination of amphigony. There is apparently nothing in the literature which touches this subject, except the statement of Tannreuther (1907) that "abundance or scarcity of food is not a factor in determining the sex in the case of the aphids," for which, however, he presents no concrete experimental evidence. Of some possible interest in connection with this problem are the experiments by Gregory (1917), who found that by subjecting parthenogenetic individuals of *Macrosiphum pisi* Kaltenbach (=*M. destructor* Johnson) to varying periods of starvation, in certain cases carrying her experiments to the maximum possible points without killing the insects, she could induce the production from apterous mothers of alate offspring, which, as shown by her check cultures, would otherwise have been apterous. It is, however, apparent from her paper, although she does not state it, that the subsequent offspring of these starved aphids were invariably parthenogenetic and that the production of amphigonous individuals was not artificially induced by the treatment. It is to be regretted that she did not carry her experiments through the succeeding generations after the mother; and the question now arises as to whether the production of amphigonous individuals is induced only by the successive and cumulative effects of starvation on several generations of parthenogenetic individuals. One point is suggested by these experiments, and that is that, as

in the case of temperature conditions, if the quantity of available food has any tendency at all to change the method of reproduction in aphids, the effect does not become apparent immediately. This question, however, needs further investigation before very definite conclusions can be reached.

Summary.

1. The sexual type of reproduction is the only one known to occur in the Aphididæ. This process takes three forms in this family: (a) amphigony; (b) parthenogenesis; and (c) pædogenesis.

2. Amphigony is considered as the more primitive method in insects. Parthenogenesis has practically supplanted it in aphid reproduction.

3. Parthenogenesis in aphids is apparently continuous and uninterrupted under favorable environmental conditions, amphigony occurring only under the influence of low temperatures and, as certain authors claim, inadequate food supply.

4. Aphids in tropical and other warm climates appear to have the tendency to reproduce exclusively by parthenogenesis. The same condition apparently obtains among greenhouse aphids in temperate climates.

5. Aphids in colder climates undergo heterogony as an adaptation to adverse environmental conditions. In certain species, the appearance of the amphigonous generation seems to be a rhythmic process, which continues to occur at definite cyclical intervals for some time after the influence of low temperature has been eliminated.

6. Nothing very definite is known about the relation of food and heterogony. If the quantity of food has any influence at all on the determination of amphigony in a parthenogenetic mother, the effect does not become manifest in the immediate offspring.

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CHINESE ANTS COLLECTED BY PROF. C. W. HOWARD.[1]

By William Morton Wheeler.

Since the publication of my paper on Chinese ants[2] Professor C. W. Howard has sent me a small collection made in Canton and the immediate vicinity. The collection comprises two very interesting undescribed species and several others which have not been previously recorded from China.

Ponerinæ.

1. *Stictoponera menadensis* Mayr subsp. *bicolor* Emery ☿—Two specimens from Leng-oo, near Canton.

2. *Diacamma rugosum* Guill. subsp. *geometricum* Sm. var. *anceps* Emery. ☿—Numerous specimens from Canton.

3. *Odontoponera transversa* Sm. ☿—Several specimens from Canton and Honan Island, on which Canton College is situated.

4. *Ectomomyrmex astutus* Sm. ☿—A single specimen from Leng-oo.

5. *Leptogenys* (*Lobopelta*) *diminuta* Sm. ☿—Five specimens from Leng-oo.

Pseudomyrminæ.

6. *Tetraponera allaborans* Walk. ♀—A single deälated specimen from Honan Island.

Myrmicinæ.

7. *Monomorium pharaonis* L. ☿ ♀—Many specimens from Canton.

8. *Monomorium carbonarium* Sm. ☿—Eleven specimens from Canton.

9. *Cardiocondyla nuda* Mayr. ☿—Three specimens from Canton.

10. *Crematogaster rogenhoferi* Mayr. ☿ ♀—Several specimens from Canton.

11. *Crematogaster biroi* Mayr. ☿—Two specimens from Canton.

12. *Pheidologeton diversus* Jerd. *4* ☿—Many workers and a single soldier from Canton. One lot of workers attending scale-insects.

[1] Contributions from the Entomological Laboratory of the Bussey Institution, Harvard University. No. 194.

[2] Bull. Mus. Comp. Zool. 64, 1921, pp. 529-547.

DOLICHODERINÆ.

13. *Dolichoderus* (*Hypoclinea*) *taprobanæ* Sm. var. *gracilipes* Mayr. ☿ ♀ ♂—Numerous specimens from Canton.

14. *Dolichoderus* (*Hypoclinea*) *affinis* Emery var. *nigricans* Emery. ☿—Numerous specimens from Tei-loi and Loh-Kong, Canton.

15. *Dolichoderus* (*Hypoclinea*) *sinensis* sp. nov. (Fig. 1).

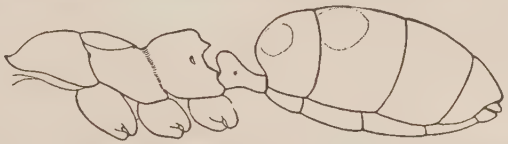

Fig.1 ***Dolichoderus (Hypoclin a) sinensis, sp. nov., worker.***

Worker. Length 3.4 mm.

Closely related to the Palearctic *D. quadripunctatus* L. but differing in the following particulars: Joints 3-7 of funiculi shorter, not longer than broad; mesonotum slightly longer, more nearly parallel-sided; base of epinotum much more elevated and convex and broader in proportion to its length; its posterior corners depressed and developed as small, rather acute teeth, not as tubercles. Petiolar node distinctly lower and more evenly rounded above in profile, the cylindrical portion behind the node longer.

Surface of head, thorax and petiole much more opaque; the foveolæ on the head and thorax more regular and more distinct. Mandibles, clypeus and pleuræ slightly shining, or lustrous, finely shagreened. Gaster very smooth and shining.

Pilosity and pubescence quite as feebly developed as in *quadripunctatus.*

Head, thorax, petiole and legs deep red, the tibiæ slightly darker; tarsi, mandibles and antennæ slightly paler, the tips of the scapes and funiculi infuscated. Gaster black; first and second segments as in *quadripunctatus,* each anteriorly with a pair of ivory yellow but somewhat larger spots.

Described from a single specimen from Canton.

16. *Technomyrmex albipes* Sm. ☿—Numerous specimens from Canton; attending mealy bugs.

17. *Iridomyrmex anceps* Roger ☿—Nine specimens from Canton.

18. *Tapinoma indicum* Forel ☿—Six specimens from Leng-oo.

FORMICINÆ.

19. *Plagiolepis longipes* Jerd. ☿—Several specimens from Canton.

20. *Plagiolepis rothneyi* Forel ☿—Numerous specimens from Canton.

21. *Paratrechina longicornis* Fabr. ☿—Numerous specimens from Canton.

22. *Paratrechina* (*Nylanderia*) *yerburyi* Forel ☿—Numerous specimens from Canton.

23. *Gesomyrmex howardi* sp. nov. (Fig. 2).

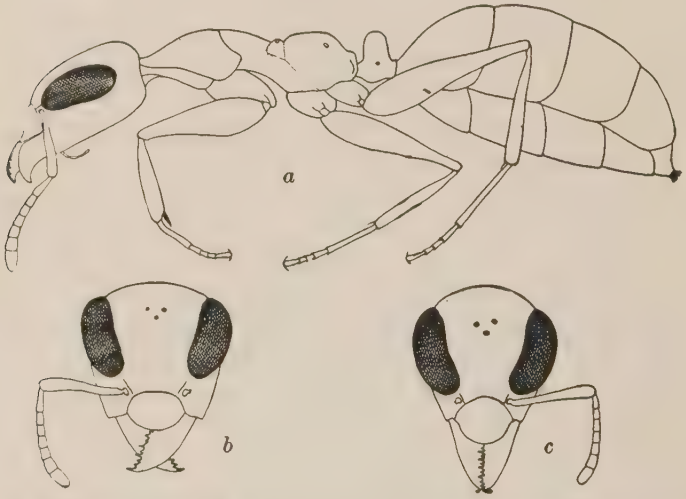

Fig. 2. *Gesmoyrmex howardi* **sp. nov. a, worker major; b, head of same, c, head of worker minor.**

Worker major. Length 3 mm.

Head, without the mandibles, a little longer than broad, broader behind than in front, with straight, anteriorly angular cheeks, convex and broadly rounded posterior border and corners, broadly and arcuately excised occipital border and rather flat dorsal and gular surfaces. Eyes very large, prominent, elliptical, fully 2½ times as long as broad, situated at the middle of the sides of the head. Ocelli minute but distinct. Mandibles rather flat, their external borders straight at the base, convex towards the tips, their apical borders straight with acute, crowded teeth, alternately long and short. Clypeus broader than long, convex but not carinate in the middle, flattened and depressed anteriorly where it projects as a broad, arcuate lobe over the bases of the mandibles. Frontal

carinæ very short, twice as far apart as their distance from the lateral borders of the head, running back towards the anterior orbits. Frontal area and groove obsolete. Antennæ short, 8-jointed, scapes somewhat thickened apically, not reaching to the posterior orbits; funiculi gradually thickened to their tips, all their joints longer than broad. Thorax long and slender; broadest through the pronotum, much narrowed at the mesonotum; pronotum seen from above elliptical, a little longer than broad, its dorsal outline evenly rounded, continued back into that of the sloping mesonotum to the constriction, which is sellate and bears on each side a swelling with one of the metanotal spiracles. Base of epinotum rising somewhat above the constriction, slightly but distinctly convex, longer than the feebly concave, sloping declivity. From above the epinotum is a little longer than broad and slightly narrower than the pronotum, the mesonotum less than half as broad as the latter. Petiolar node nearly as high as the epinotum, transverse, erect, as thick above as below, its anterior and dorsal surface rounded, its posterior surface more flattened; seen from behind it is broader above than below, with broadly rounded superior corners. Gaster moderately large, elliptical, its first segment not longer than the second. Legs moderately long, femora all distinctly incrassated at the base, tibiæ subcylindrical, their bases slightly constricted. Tarsal claws slender and rather straight.

Shining; finely but sharply shagreened; thorax and petiole, except the pronotum, subopaque, finely and densely punctate. Mandibles, clypeus and front of head with fine, dense, superficial, longitudinal striæ.

Hairs and pubescence whitish; the former absent except on the clypeus, palpi and tip of the gaster; the pubescence extremely short and dilute, distinct only on the antennal funculi.

Dull honey yellow; legs scarcely paler; mandibles, clypeus and antennæ more whitish; eyes black; mandibular teeth reddish brown.

Worker minor. Length 2. 3mm.

Differing from the major in its smaller size, narrower head, proportionally larger, more prominent and slightly more reniform eyes, even more minute ocelli, shorter, less angular and anteriorly more convergent cheeks; longer and more anteriorly produced clypeus and more slender mandibles.

Described from two specimens from Canton, both from the same vial in which they were mingled with several other ants.

This is the fourth species of *Gesomyrmex* to come to light. The genus was established by Mayr in 1868[3] for a species, *hoernesi*, from the Baltic Amber. Emery, in 1891, referred a peculiar form, *corniger*, from the Sicilian Amber to the same genus,[4] but I have recently made it the type of a distinct though allied genus, *Sicelomyrmex*.[5] In the same paper I described a second species of *Gesomyrmex*, *annectens*, from the Baltic Amber. In 1892 Ernest Andre[6] described and figured an extant species, *capperi* from the Kapouas Basin of Borneo. This insect has not been seen since. It is therefore of considerable interest to find on the Asiatic continent a second living *Gesomyrmex*. It is evident that the Bornean and Chinese species are very rare and probably vanishing relicts of a group of Formicinæ with huge eyes and 8-jointed antennæ, which was represented by numerous species during the Oligocene and Miocene Tertiary. To this group we must also assign the allied genera *Sicelomyrmex* and *Dimorphomyrmex*. The latter is known from two species from the Baltic Amber, *theryi* Emery and *mayri* Wheeler, and three extant species, *andrei* Emery and *janeti* Ern. André from Borneo, and *luzonensis* Wheeler from the Philippines.

Judging from André's figures and description, *Gesomyrmex howardi* differs from *capperi* in its smaller size, less reniform eyes, broader pronotum, more cylindrical mesonotum, more convex epinotum, thicker petiole and more uniform honey-yellow color. André's specimens measured 3.5 to 4 mm. and seem to have been minor workers. Since the major worker measures in all probability not far from 4.5 mm. *capperi* must be considerably larger than the Chinese species. The amber specimens which I described as *annectens* may, perhaps, be major workers of *hoernesi*, but the measurements seem not to favor this supposition, since *annectens* varies from 4 to 6 mm., *hoernesi* from 2.5 to 6 mm. The great similarity of all four described species of *Gesomyrmex* leads me

[3] Die Ameisen des baltischen Bernsteins. Beitr. Naturk. Preussens. Physik. Ökon. Ges. Königsberg 1, 1868, pp. 1-102, 5 pls.

[4] Le Formiche dell'Ambra Siciliana nel Museo Mineralogica dell'Universita di Bologna. Mem. R. Accad. Sc. Ist. Bologna (5) 1, 1891, pp. 141-165, 3 pl.

[5] The Ants of the Baltic Amber. Schrift. physik. ökonom. Ges. Königsberg 55, 1914, pp. 1-142, 66 figs.

[6] Voyage de M. Chaper a Borneo. Catalogue des Fourmis et Description des Espèces Nouvelles. Mém. Soc. Zool. France 5, 1892, pp. 46-55, 5 figs.

to suspect that the amber specimens, which I examined, may represent more than two very closely related forms. The worker major of *G. howardi* shows that the genera *Gesomyrmex* and *Dimorphomyrmex* are more closely related than was supposed. Nevertheless, the gizzard of *D. andei* figured by Emery[7] is quite different from the gizzard of *G. capperi* figured by André. In the former insect the organ is short and broad with short, terminally reflected calyx-lobes, in the latter long and slender and more as in *Camponotus* and *Oecophylla*.

The thickened bases of the femora of *G. howardi* indicate that this ant can jump like the large-eyed *Gigantiops destructor* Fabr. of the Neotropical Region, and the rather feeble tarsal claws would seem to indicate that it is not arboreal but nests in the ground.

24. *Camponotus* (*Myrmoturba*) *nicobarensis* Mayr ☿ ♀—Many specimens from Honan Island, Canton.

25. *Camponotus* (*Myrmoturba*) *mitis* Sm. ☿—Many specimens from Canton.

26. *Camponotus* (*Myrmoturba*) *barbatus* Roger var *albosparsus* Forel ☿—Eight specimens from Canton.

27. *Camponotus* (*Myrmosericus*) *rufoglaucus* Jerd. subsp. *paria* Emery ☿—Numerous specimens from Tei-loi, Canton.

28. *Polyrhachis* (*Myrma*) *mayri* Roger ☿—Three specimens from Canton.

29. *Polyrhacis* (*Myrmhopla*) *dives* Sm. ☿ ♂—Numerous specimens from Canton.

30. *Polyrhachis* (*Cyrtomyrma*) *rastellata* Sm. subsp. *laevior* Roger var. *debilis* Emery ☿—Three specimens from Canton.

[7] Descriptions de deux fourmis nouvelles. Ann. Soc. Ent. France 63, 1894, pp. 72-74, 2 figs.

ON SOME RECENT REMARKS ON THE PHYLOGENY OF HOMOPTERA.

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In a recent publication Dr. G. C. Crampton[1] remarks: "In any phylogenetic study we must consider the lowest representatives rather than the highly specialized members of a group."

Unfortunately Dr. Crampton, on more than one occasion when discussing the phylogeny of Homoptera, has not followed this good advice. In a recent paper[2] he has compared the wing of a Psyllid and a wing of a Psocid and concluded that their similarity is due to their common ancestry. The Psocid wing he figures is a specialized one and not the lowest representative of the group, and Psyllidæ are highly specialized Homoptera. Any similarity between the venation of the wings of these two insects is therefore of no phylogenetic significance, but due to convergence.

As I am not an authority upon the Psocidæ I can only support my contention by a comparison of the Psocid wing figured by Dr. Crampton with such genera as *Amphientomum* and *Cymatopsocus,* where the venation is more generalized but still too specialized to be ancestral to the Homoptera.

My contention that the Psyllidæ do not represent the primitive type of Homoptera is based upon a detailed study of the suborder. The evidence is too lengthy to give in detail in this paper, but the following is a brief summary of some of the points.

The Hemiptera form a homogeneous and monophyletic order characterized by a unique shape and arrangement of the mouth parts found in no other order of insects. Although the order is of great size and the forms found within it are very diverse, yet the mouthparts are always of the same type and far more uniform than is found in any other of the large orders. That such a type of mouth organs should have arisen independently in two or more groups seems highly improbable.

The nearest approach to the Hemipterous mouthparts is found

[1] Proc. Ent. Soc. Washington 23, 2, p. 37 (1921).
[2] Ent. News XXII, No. 4, p. 97-105 (1921).

in the Thysanoptera. But here we find two distinct types of mouth organs and both are so dissimilar to the Hemiptera that it is not likely that one arose from the other. The Psocidæ possess a semi-free maxillary style which may represent a condition found in the ancestors of the Hemiptera, but no Psocids that we know today could have been that ancestor because they are far too specialized in certain directions.

The most generalized head in the Hemiptera is found among the Heteroptera where the gula is well developed or very large, the head capsule of more normal shape and position, the labium is four-jointed and consists of a submentum, mentum, subgalea with amalgamated paraglossa and lacinia. In some few species the labial palpi are also present. In the Homoptera the gula has disappeared or is represented only by a membrane, and the labium is in close association with the pronotum. The reduction of the gula has drawn the head downward and under, bringing the top of the head to the front and altering the whole shape of the head capsule. In this respect the Cicadoidea are more primitive than the Fulgoroidea.

In the Sternorhynchi this line of evolution of head set up in the Auchenorhynchi is carried to a still greater extent. In the Psyllidæ the clypeus, frons (bearing the phrayngeal muscles), tentorial structure and the labium have separated themselves from the head capsule and become still more closely connected with prosternum. To accommodate the long mandibular and maxillary setæ an invagination at the base of the labium penetrates the prothorax. In the Coccidæ the reduction of the head capsule is carried to the extreme, so that the frons, clypeus, tentorial structure, labium and the styles are isolated in a membraneous area and appear to be thoracic structures. The line of evolution of the head of the Hemiptera is so well defined that any student of comparative morphology, except an extreme mutationist, will agree that the Psyllidæ are highly specialized and do not represent the ancestral form.

The Hemiptera can be divided into two groups on the condition of the alimentary canal. In the Heteroptera, Fulgoroidea and Cicadellidæ this is simple. In the Cicadadæ, Cercopidæ, Membracidæ and the Sternorhynchi the posterior portion of the midgut is in intimate contact with the anterior portion and forms a filter

chamber. This is of a simple nature in the Psyllidæ. The fact that this division separates the Cicadellidæ and the Membracidæ raises difficulties, as they are otherwise so closely related. It seems improbable that such a condition arose in two or more groups independently. It seems more probable that it has been lost in two or more groups independently. Kershaw has shown that the connection is fully developed in nymphs when hatched, so that it is an embryonic character and not a later development to meet special conditions.

Judging by venation the Hemiptera must have divided into two groups, the Homoptera and Heteroptera, early in the history of the order, but not early enough, in my opinion, to justify making it into two orders. A very slight study of the venation of the Homoptera shows that the nearest approach to the hypothetical ancestral type is not found among the Psyllidæ but among the Auchenorhynchi.

A study of the hind legs also indicate a state of high specialization in the Psyllidæ.

Again, in discussing the male genitalia of Homoptera, Dr. Crampton has offended against his own advice. Although there are several distinct types of both male and female genitalia among the Auchenorhynchi he has selected Ormenis as the type to homologize with other orders. But unless it can be shown that this genus possesses a generalized type, any homologies drawn from it are of little phylogenetic value.

Among the Cicadoidea we have two distinct types of male genitalia and a third in the Fulgoroidea. Cicadadæ have no genital styles or these are only rudimentary and are articulated and the aedeagus comparatively simple. This is most likely specialization by reduction. In the other Cicadoidea there are two pairs of appendages, the outer pair or plates and the inner pair. In some forms the outer pair are amalgamated together and appear to be part of the pygofer. In the Membracidæ the aedeagus is generally simple; in the Cercopidæ it is often complex; in the Cicadellidæ it is of various forms, some of which are highly complex and others greatly reduced. In the Fulgoroidea there is only one pair of styles, which in certain cases are amalgamated into a single organ.

Both the inner styles of the Cicadoidea and the styles of the

Fulgoroidea are in connection with the base of the ædeagus. They are probably homologous.

In the Fulgoroidea there is great diversity of structure and it is very difficult to decide which is the most generalized. In certain forms (i. e., certain Delphacidæ) it is of a simple tubular nature with a small ring round its base. In other forms this ring is greatly enlarged and forms an outer tube around the inner tube. In some forms there are even three tubes and one may be exceedingly complex.

Until we understand the homologies of the various types within the order Hemiptera any homologizing with other orders is but guesswork and not scientific evidence, although the guesses may be correct.

Dr. Crampton has so often associated the Psocidæ and Psyllidæ together, as if the latter were descended from the former and all else followed naturally, that there is a possibility of readers not acquainted with the Homoptera accepting that conclusion as well founded. For that reason I raise the above objections.

Certain remarks in Dr. Crampton's papers leads one to believe that he holds views on evolution considerably different to those of the majority of biologists; or his metaphors are so anthropomorphic that they are misleading. As an example of this I quote from a recent work:[3]

"Taking their anatomy as a whole, the Hymenoptera show undoubted affinities with the Neuropteroid insects (i. e., the Neuroptera, Mecoptera, Tricoptera, etc.), but they also present certain points of similarity to the Psocoid insects, such as the Homoptera, Thysanoptera, Psocida, etc. The lines of development of all of these forms apparently arose from ancestors intermediate between the Zoraptera (with the Isoptera) on the one side, and the Coleoptera (with the Dermaptera) on the other—much as a family of children inherit traits from the father's side—and I am inclined to consider that the Hymenoptera inherited their social tendencies from the side of the Zoraptera (with the Isoptera) while their type of genitalia apparently comes from the side of the Coleoptera (with the Dermaptera)."

Does Dr. Crampton believe that new orders arise as hybrids from the crossing of individuals belonging to different orders, or are things not what they seem in the quoted paragraph?

[3] Ent. News XXXII 5, (1921) p. 137.

NOTES AND DESCRIPTIONS OF A FEW NORTH AMERICAN DOLICHOPODIDÆ (DIPTERA).

By M. C. Van Duzee
Buffalo, N. Y.

Diaphorus hirsutus sp. nov.

Male: Length 4–4.5 mm.; of wing 4 mm. Face narrow, silvery white. Palpi yellow, proboscis brownish. Front nearly opaque with grey pollen, the ocular tubercul more blackish; ocullar bristles long, a bristle close to the orbit on each side curves forward. Antennæ black; first joint long, hairy above; second joint large with rather long bristles at tip; third small, not as large as second, rounded at tip; arista basal, long, pubescent. Lateral and inferior orbital cilia whitish, five or six of the upper cilia on each side black.

Thorax nearly opaque with brown pollen, the median line on the dorsum and the scutellum green, quite shining; acrostichal bristles small, in a single row; six large dorsocentral bristles on each side; scutellum with four large bristles on its margin; pleuræ more blackish with gray pollen, its posterior edge yellow. Abdomen yellow with the posterior edge of first segment, large triangles on the dorsum of second, third and fourth, which nearly reach the preceding segment on the median line and the sides on the posterior margin of the segments, and nearly the whole of fifth and sixth segments, shining green or bronze; hairs on the dorsum rather long, especially near the base of the abdomen, those on the sides of the abdomen yellowish. Hypopygium rather conspicuous, blackish, still more or less yellow towards the ventral point; its appendages small brownish lamellæ, it has about four rather long and conspicuous, although not very stout bristles at tip.

Coxæ yellow; middle pair with a blackish streak on outer side; fore and middle pairs with black bristles on the apical half of their anterior surface. Femora and tibiæ yellow, very hairy; fore femora with a few slender bristles on the apical part of the lower posterior edge, which are as long as the width of the femora; posterior femora infuscated on apical half of upper surface, and the slender hairs of their lower surface as long as the width of the femora; bristles on upper surface of the tibiæ small and incon-

spicuous. Tarsi hairy, more or less blackish from the tip of the first joint; fore and middle tarsi nearly as long as their tibiæ, the former with fourth and fifth joints of about equal length. All fifth tarsal joints with bristle-like hairs at tip; their pulvilli much enlarged and with the empodium also elongated and hairy, appear-

EXPLANATION OF FIGURES.

Fig 1, **Diaphorus hirsutus** sp. nov., wing.; Fig. 2, **Proarchus violaceus** sp. nov., antenna; Fig. 3, **Proarchus violaceus** sp. nov., Hypopygium; Fig. 4, **Leucostola terminalis** VanDuzee, hypopygium of male; Fig. 5, **Thripiticus longicauda** sp. nov., hypopygium of male; Fig. 6, **Thripticus nigripes** sp. nov., hypopygium of male; Fig. 7, **Paraclius ornatus** sp. nov., wing; Fig. 8, **Paraclius ornatus** sp. nov., last four joints of fore tarsus; Fig. 9, **Paraclius ornatus** sp. nov., outer appendages of the hypopygium of male.

ing like claws when seen with a low-power lense; hind tarsi scarcely as long as their tibiæ, the first and second joints of nearly equal length. Calypters and halteres pale yellow, the former with a brown tip and yellowish cilia.

Wings (Fig. 1) grayish; first vein reaching a little more than one-third the distance from the root of the wing to tip of second vein; third vein bent backward at tip; last section of fourth vein with a quite abrupt bend at a point opposite the tip of fifth vein,

from which point it is parallel with third vein and ends in the apex of the wing; sixth vein reaching the wing margin; anal angle rounded but rather full, the wing being of somewhat parallel width.

Female: Two females which seem to belong here have the face wide, still rather narrow for a female, white. They have only the second and third abdominal segments yellow on the dorsum, these have the same metallic triangles as are found in the male; the legs and feet have only short hairs; the scutellum has one pair of bristles; the second vein reaches only half the distance to the tip of second; last section of fourth vein is nearly straight and parallel with third.

Described from three males and two females from California; the males were taken at Berkeley, Calif., May 10, 20 and 28, 1915; the females at Alpine, San Diego County, April 8 and 11, 1915. Type in the author's collection.

Diaphorus fuscus nom. nov.

D. adustus Van Duzee, Bulletin of the Buffalo Society of Natural Sciences, Vol. XI, p. 173, 1915, as the name *Diaphorus adustus* Wied. of Europe has precedence. I would change the name of my species to *Diaphorus fuscus*.

Leucostola terminalis Van Duzee.

In the Entomological News, Vol. XXV, p. 405, I described a female under this name. Since then I have seen several male specimens, one of which is in my collection. It agrees with the female described in having the first antennal joint wholly yellow, it also has the reddish coppery stripes above the root of the wing, although they are not as conspicuous and are divided into two spots, one at the suture and one above the root of the wing. It has the last two joints of the middle tarsi, a little flattened, of about equal length, each nearly as wide as long, the two taken together about as long as the third joint; hind tibiæ black at tip for nearly one-fourth their length; hind tarsi wholly black, the second joint a little longer than the first; last section of fourth vein only a little bent at its middle; hypopygium (Fig. 4) with its lamellæ developed into long hairy filaments, and with two bristles at tip, which are slender and hair-like.

Proarchus (*Phylarchus*) Aldrich.

Dr. Aldrich described this genus from two females taken in Mexico, and has placed the genus in the Thinophilinæ. I have a species found in New York and Virgina which I am placing in that genus. It has the antennæ and plumose arista as in his species, the face of the female is as he described it (about as in Pelastonerus). My specimens have distinct acrostichal bristles, while his species was destitute of these bristles. The hypypygium of this new species is large, extending forward under the venter, as in Dolichopus and its lamellæ are as in that genus (fig. 3). If the male of his species proves to have the hypopygium as in my species, it would place the genus in Dolichopodinæ, I should say after Polymedon, or perhaps after Sarcionus and next to Pelastoneurus, from which it is separated by its nearly parallel third and fourth veins.

This would place the genus near the European genus Poecilobthrus Mik. The female of the only species of that genus that I have seen, *P. nobilitans,* has the face formed very much as in Pelastoneurus and has a plumose arista. I should place our species in that genus, only the second and third veins are not approximated nor the wing of the male ornamented with black as in all species of Poecilobothrus known to me.

Proarchus violaceus sp. nov.

Male: Length 4–4.5 mm.; of wing 4 mm. Face wide, covered with grayish-white pollen, sometimes almost silvery, upper portion a little concave and with a slightly depressed median line, the lower part rather short and slightly convex. Front dark violet, sometimes almost black, a little dulled with brown pollen. Palpi yellow with black hairs and a little white pollen. Antennæ (fig. 2) yellow; third joint sometimes mostly brown, short, somewhat oval in outline; arista dorsal, distinctly plumose, although the hairs are not long. Orbital cilia wholly black.

Dorsum of the thorax violet with the lateral and anterior margins quite broadly greenish; acrostichal bristles rather large, in two rows; scutellum violet with two large and two very small bristles on its margin; pleuræ more black with gray pollen. Abdomen green with white pollen; incisures black; hind margins of segments with stiff black bristles. Hypopygium (fig. 3) formed

about as in Dolichopus, black, greenish on basal half; its lamellæ large, somewhat oval but tapering into the stem, yellowish with a wide black border on the apical margin, which is jagged and fringed with long black bristles.

Coxæ, femora and tibiæ yellow; middle coxæ blackened on outer surface, hind ones a little infuscated at base; fore coxæ covered with black hairs on their anterior surface, hind ones with one large and one small bristle on outer surface. Middle and hind tobiæ each with four blackish spots on upper surface where the bristles are inserted. Fore tarsi a little longer than their tibiæ, a little blackened from the tip of the first joint; middle and hind tarsi black from the tip of the first joint, the latter with the first joint distinctly shorter than the second. Calypers and halteres pale yellow, the former with black cilia.

Wings grayish, tinged with brown in front of the third vein; broad, distinctly expanded at tip of fifth vein; anal angle prominent, although the hind margin of the wing is slightly excavated at tip of sixth vein; costa slightly thicker from the tip of the first vein; last section of fourth vein nearly straight, ending a little before the apex of the wing, nearly parallel with third vein, which is a little bent backward so as to approach fourth vein a very little at tip; cross-vein a little more than its length from the wing margin, measured on fifth vein.

Female: Face a little wider than in the male; color of head, thorax, abdomen and legs as in the male; wings as in the male, but not quite as wide at tip of fifth vein.

Described from three males and three females; I took the holotype and allotype at Dayton, Erie County, N. Y., July 5, 1920; two males were taken by Mr. Banks at Falls Church, Va., May 30; one female was taken by Mr. Hine at Kent, Ohio, June 18; and one female was taken at Bridgewater, Mass., July 11.

Table of North American Species of Thripticus. Males.

1. Femora black, or green 2
   Femora yellow 4
2. Hypopygium with yellow lamellæ (Calif.), *longicauda* sp. nov.
   Hypopygineal lamellæ brown 3
3. Hypopygium somewhat oval in outline, rather thick (Calif., Mex., N. Y.) ..... *fraterculus* Wh.

Hypopygium rather slender, tapering towards its apex, more conical than oval (Nev.).....*nigripes* sp. nov.

4. Venter and part of the dorsum of the abdomen yellow..... 5
Abdomen without yellow, except sometimes on the venter.. 6

5. Whole of sixth abdominal segment and base of the hypopygium yellow (W. I.).....*cupuliferous* Ald.
First abdominal segment and more or less of the base of the hypopygium yellow (Ind., Mo., N. C., Ga., D. C., N. Y.).....*abdominalis* Say

6. Hypopygium ovipositor-like, bent under the abdomen (W. I.).....*singularis* Ald.
Hypopygium normal..... 7

7. Fourth vein bent backward to meet the cross-vein, forming a distinct angle at this point (W. I.).....*minor* Ald.
Fourth vein only gently bent at the cross-vein..... 8

8. Antennæ yellow, or yellowish..... 9
Antennæ black.....10

9. Capsule of hypopygium truncate at tip (Fla.)....*vietus* V. D.
Capsule pointed at tip (N. Y., Md.)...*muhlenbergiæ* J. & C.

10. Hypopyginal lamellæ sessil, rounded at tip (N. Y.) *tectus V. D.*
Lamellæ somewhat petiolate.....11

11. Lamellæ nearly round in outline (Wis., N. Eng., Mo., N. Y., Ill., Wyo., Ont.).....*willistonii* Wh.
Lamellæ decidedly longer than wide.....12

12. Thorax with violet reflections and with a golden spot on the posterior slope before the scutellum (Ga.) *aurinotatus* V. D.
Thorax green or purple with the posterior slope green....13

13. Thoracic dorsum purple; hypopygium rather pointed, its lamellæ pointed at tip (Mex.).....*pusillus* Ald.
Dorsum of thorax green; hypopygium rounded at apex, its lamellæ rounded at tip (N. Y., Ont.).....*comosus* V. D.

Thrypticus nigripes sp. nov.

Male: Length 1.75 mm. Face, front, thorax and abdomen dark shining blue-green. Face very narrow below. Antennæ and mouth parts black. Bristles of the thorax and the conspicuous hairs on the abdomen yellow. Hypopygium blue-green, its hairs yellow;

the lamellæ brown, large, about as long as the main portion of the hypopygium, rather bare (fig. 6).

Coxæ, legs and feet black, except the extreme tips of the coxæ and the trochanters, which are yellowish. Calypters, their cilia and the halteres yellow.

Wings nearly hyaline; third and fourth veins nearly parallel.

Female: Face a little wider; otherwise about as in the male.

Described from one male and two females which I took at Wells, Nev., June 6, 1915. Type in the author's collection.

The wings in all my specimens are in poor condition. This is very much like *T. fraterculus* Wh., it differs in having the capsule of the hypopygium conical, not oval as in Wheeler's species, and the lamellæ much longer and less hairy.

Thrypticus longicauda sp. nov.

Male: Length 3 mm. Face green, narrow below, the lower edge and the palpi covered with white pollen. Front blackish. Antennæ black, small. Lateral and inferior orbital cilia white. Frontal bristles black.

Thorax green with bronze reflections; there is but one bristle left on the thorax and that is black with the tip more whitish, the minute hairs on the anterior portion are yellow. Abdomen long and slender, green, its hairs and the bristles on the hind margins of the segments are yellow, but they are small and inconspicuous. Hypopygium long and slender, green, its hair yellow (fig. 5); its lamellæ very long, yellow, with a few yellow hairs.

Fore coxæ yellow with white hairs, its basal half on the anterior surface green. Middle and hind coxæ and all the femora green, with the tips of coxæ, extreme base of middle and hind femora, apical third of fore, and apical two-thirds of middle femora, tips of hind femora, and all tibiæ and tarsi yellow. Fore and middle tarsi nearly twice as long as their tibiæ. Second joint of hind tarsi longer than the first. Calypters, their cilia and the halteres yellow.

Wings grayish; costa black; veins brown: third and fourth veins parallel, the fourth ending in the apex of the wing; last section of fifth vein nearly three times as long as the cross-vein.

Female: Face wider; thorax with black and yellow bristles mixed; coxæ and femora mostly black; tibiæ and tarsi yellowish

brown; fore tarsi scarcely one and a half times as long as their tibiæ. Wings as in the male.

Described from one pair which I took at San Francisco, California, May 12, 1915. Type in the author's collection.

Paraclius minutus sp. nov.

Male: Length 2.5 mm.; of wing 2 mm. Face rather narrow, covered with white pollen, the suture near apical third, lower portion flat. Palpi blackish with a little white pollen and black hairs. Front almost opaque with brown pollen. First two antennal joints yellow; third mostly brown, small, rounded at tip. Arista long with long pubescence, but scarcely plumose. Inferior orbital cilia whitish.

Thorax greenish, dorsum more brown with coppery reflections, which form a median vitta extending to the hind margin of the scutellum. The ante-alar black spots distinct but nearly divided by the green of the dorsum; when viewed from behind there are four silvery-white spots visible, a large one at the lower edge of the front end of the black spot, and a very small one above the root of the wing; pleauræ and coxæ covered with white pollen. Abdomen green; the spots of white pollen on its sides not very conspicuous. Hypopygium rather small, entirely sessel, black; its lamellæ quite small, black, they appear to be nearly bare on their edges.

Coxæ yellow, middle ones blackened on basal half, hind ones a little blackened at base; anterior pair with black hairs on their front surface. Femora and tibiæ yellow. All tarsi black from the tip of the first joint. Calypters and halteres yellow, the former with black cilia.

Wings tinged with brownish gray; first section of costa not thickened, last section of fourth vein rather abruptly bent beyond its middle, beyond which it curves forward so the tip is near the tip of the third vein; last section of fifth vein a little longer than the cross-vein.

Female: About like the male in the width of the face, color and venation, except that the last section of the fifth vein is a little longer.

Described from two males and three females which I took in

Florida, four at Bradentown and one pair at Anna Maria Key, all in March. Type in the author's collection.

This is much like *P. quadrinotatus* Ald., but does not have the anta-alar spots divided as in that species, and these spots are not as large.

Paraclius ornatus sp. nov.

Male: Length 3–3.5 mm.; of wing, the same. Face narrow, silvery-white. Palpi small, yellow, with a black bristle at tip. Proboscis yellow, with a fringe of little yellow hairs on its edge. Front silvery-white, widened above. Antennæ wholly black or with the lower edge of the first joint slightly yellowish; third joint small, about as long as wide, scarcely pointed at tip. Arista dorsal, pubescent. Lower orbital cilia yellowish, slender.

Thorax green with bronze reflections, a little dulled with white pollen; there are no ante-alar black spots. Abdomen green with quite abundant white pollen. Hypopygium small, but little longer than thick, extending forward under the venter, black with green reflections; its outer appendages look like small yellow lamellæ (fig. 9) with black bristles, but they seem to be united at base as in the figure; the inner appendages are darker and rather small, they are deeply slit into three parts at tip.

Coxæ, femora and tibiæ yellow. Fore coxæ with black hairs on the inner edge of their anterior surface; middle and hind coxæ each with a long black bristle on outer side, the former darkened on the outside. Hind femora scarcely darker at tip above, their tibiæ more distinctly brown at tip. Middle and hind femora each with a slender preapical bristle, the former also has smaller ones below near the tip. Fore tarsi (Fig. 8) more than one and a half times as long as their tibiæ, first two joints yellow with their extreme tips blackish, second slightly longer than the first and very thin, it is about as long as the last three joints taken together; third and fourth joints black, compressed and widened, fringed above with little black hairs; fifth yellow with the base narrowly black. Middle tarsi longer than their tibiæ, black from the tip of the first joint. Hind tarsi equal to their tibiæ in length, wholly black, still sometimes the first joint is yellowish at base, first joint shorter than the second. Calypters and halteres yellow, the former with yellow cilia, which appears nearly black in certain lights.

Wings (fig. 7) grayish; third vein bent backward at tip; last section of fourth vein bent at its basal third, approaching third, but bending back a little toward its tip so as to be parallel with third vein for its apical third and ending in the apex of the wing; last section of fifth vein twice as long as the cross-vein; anal angle of wing rounded but rather prominent.

Female: Like the male in general color and the form of the wings. The face is not very wide and is hollowed out almost to its lower edge; face and front wholly silvery-white, proboscis narrowly blackish on the edge, which is fringed with quite conspicuous black hairs. Ovipostor yellowish with a circlet of short, blunt spines at tip. Fore tarsi blackened from the tip of the first joint; their second joint about three-fourths as long as the first.

This female is easily recognized by its venation, together with the silvery front and yellow proboscis and ovipostor.

Described from many males and females. I took them in Williamsville, Erie County, N. Y., August 8 and 29, 1920. Mr. Burns took many at the Palisades, N. J., July 5, 1920.

Holotype and Allotype in the author's collection and taken at Williamsville, N. Y.

Those I took were flying around the surface of the water which was running over the rocks, and resting on the moss and rocks in the little falls, very much as does *Liancalus*. The very short hypopygium would almost separate this species from *Paraclius,* but it is entirely disengaged although sessil and extends a little under the venter.

Paraclius ovatus Van Duzee.

This is the same as *Paraclius venustus* Aldrich, and is therefore a synonym of that species. Dr. Aldrich reports it as abundant in the West Indies and Mexico. I have seen specimens from Georgia and Costa Rica.

CICADELLA GOTHICA SIGN.—A CORRECTION.

By Geo. W. Barber,
U. S. Bureau of Entomology, Arlington, Mass.

In Vol. XXVII, page 147, 1920, of this journal, I have recorded the occurrence of *Cicadella hieroglyphica* (Say) from Massachusetts. The record was an error and was based on a determination submitted to me which, at the time, I had no reason for questioning. The insects recorded under this name are all *Cicadella gothica* Sign., as are all of a large number of specimens from New England at hand.

The confusing of these two species, which has so often happened, is further made possible by the discovery of a dark variety of *gothica* which resembles *Cicadella hieroglyphica,* var. *dolobrata* Ball very closely indeed. This variety seems to be undescribed, and as to its future collection may again lead to a confusion of these species, it may be well to characterize it at this time.

Cicadella gothica, var. *atra* var nov.

General structure and size of *gothica:* Shining black, markings on anterior half of vertex nearly as in *gothica,* except that the yellow area surrounding the black apex is narrowly produced posteriorly for a third the length of the vertex. The black markings on the posterior half of the vertex confused, so that this portion appears solidly black with some light points indicating the yellow markings of *gothica;* eyes irregularly margined with yellow; margins of clavus light. Beneath, black; tips of femora, tibiæ and tarsæ lighter; front, dark brown, median stripe tawny.

One male taken at Lexington, Mass., September 8, 1920.

This variety is distinct from any dark forms of the typical insect that I have seen, although dark individuals are not uncommon.

SPIDERS FEEDING ON SMALL CYPRINODONTS.

By T. Barbour,
Museum of Comparative Zoology, Harvard University.

This spring was unusually dry in Southern Florida, especially during March and early April. Ponds were low and even the large lakes were considerably reduced in area. This condition may have influenced the habit which I observed and which Mr. Banks and Mr. Emerton have kindly suggested my recording.

While fishing for bass in the upper St. John River, above Lake Washington, where the river is a narrow, sluggish stream, I have always camped to cook my midday meal on a willow tussock in a shallow slough, which offers about the only chance to build a fire in this very boggy country. This year the water in the little bayou was low and the water hyacinths and lettuce plants usually afloat were resting with their roots on the mud in the shallows. The vegetation swarmed with Dolomedes, but then these spiders always seem to have a predilection for creeping about on the floating lettuce, especially. The water, both beneath the plants and in the little open spaces between them, teemed with several species of cyprinodont fishes, of which a Gambusia, beyond doubt affinis, was the most abundant.

After eating, I rested quietly awhile in the stern of my boat, which was partly hauled up on the tussock, hence quite motionless. A tiny flash of silver caught my eye, and I looked again, to see a spider carrying a small dead fish, perhaps an inch long, across a wide leaf to the dark interior of a large lettuce cluster. I thought that probably the spider had found a dead fish by chance, and I relit my pipe, when about six feet away in another direction the episode was repeated. This time the little fish was still struggling feebly in the spider's cheliceræ. Later I saw a third fish being carried off which was dead and quite dry. At the time I presumed that the habit of catching fish was probably well known and I thought no more about the happening until I spoke to my friends and searched the literature with small results.

McCook, in his "American Spiders and their Spinning Work," (Vol. 1, 1889, p. 236, fig. 219), pictures an enormous spider riding on the back of a moribund and gigantic carp, if the relation of

the size of the fish to that of the surrounding lily leaves is normal. The accompanying story of the unique event is too flamboyant to be very convincing. Comstock (Spider Book, 1912, p. 186), offers no original observations but adds, "Several apparently well-authenticated instances of the destruction of small vertebrated animals, including birds, a mouse, a fish and a snake, by spiders that are much smaller than the Avicularia are given by McCook. But, of course, all such occurrences are exceptional." I presume that, given conditions such as I have described, small fish may offer an easy and frequent prey for spiders with the habits of Dolomedes. Otherwise the opportunity to secure such prey cannot be very frequent. The species involved I believe to have been *Dolomedes tenebrosus.*

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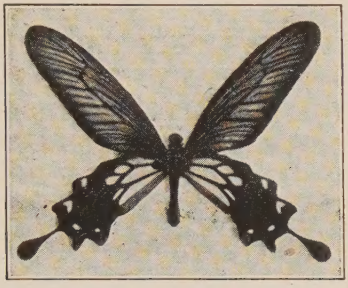

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